

For Comments Only**BUREAU OF INDIAN STANDARDS****Draft Indian Standard  
HOT ROLLED CARBON STEEL SHEET AND STRIP  
(Sixth Revision of IS 1079)****ICS 77.140.50****Not to be reproduced without the permission of  
BIS or used as STANDARD****Last date for receipt of  
comments is 30 08 2007****FOREWORD**

(Formal clauses will be added later on)

While reviewing this standard, in the light of experience gained during these years, the Committee decided to revise it to bring in line with the present practices being followed by the Indian industry and overseas standards of hot rolled carbon steel sheets.

In this revision the following changes have been made:

- a) Chemical and mechanical properties have been aligned with the corresponding International Standard.
- b) The clauses 3.2, 3.3, 11 and 16.1 have been modified.
- c) A new grade HR5 has been added, for cold rolling.
- d) Amendment Nos. 1, 2, 3 and 4 have been incorporated.
- e) A new clause on references has been incorporated.
- f) International grades designation system has been adopted, simultaneously old designations have also been given.
- g) Requirements of dimensions and tolerances have been separated from the standard and adopted ISO 16160:2005
- h) The requirements of IS 11513:1985 have been incorporated in the standard

The revised standard shall supersede IS 11513:1985 Specification for Hot Rolled Carbon Steel Strip for Cold Rolling Purposes

For all the tests specified in this standard (chemical/physical/others), the method as specified in relevant ISO Standard may also be followed as an alternate method.

While revising the standard assistance has been derived from ISO 3573:1999 Hot rolled carbon steel sheet of commercial and drawing qualities

For the purpose of deciding whether a particular requirement of this standard is complied with, the final value, observed or calculated, expressing the result of a test or analysis, shall be rounded off in accordance with IS 2:1960 'Rules for rounding off numerical values (*revised*)'. The number of significant places retained in the rounded off value should be the same as that of the specified value in this standard.

**1 SCOPE**

This standard covers the requirements for hot rolled carbon steel sheets including pack rolled sheets and strips intended for cold forming, drawing and general engineering purposes.

## 2 REFERENCES

The following standards contain provisions which through reference in this text, constitute provision of this standard. At the time of publication, the editions indicated were valid. All standards are subject to revision and parties to agreements based on this standard are encouraged to investigate the possibility of applying the most recent editions of the standards indicated below:

<b>IS No.</b>	<b>Title</b>
228	Method for chemical analysis of steel
1599:1985	Method for bend test (second revision)
1608:2005	Metallic materials – Tensile testing at ambient temperature ( <i>third revision</i> )
1730:1989	Dimensions for steel plates, sheets and strips and flats for general engineering purposes (second revision)
8910:1978	General technical delivery requirements for steel and steel products
10175(Part 1):1993	Mechanical testing of metals-Modified erichson cupping test – sheet and strip Pt 1 Thickness up to 2 mm ( <i>first revision</i> )
Doc: MTD 4(4693)	Continuously cold-rolled steel sheet products – Dimensional and shape tolerances ( <i>Based on ISO 16160:2005</i> )

## 3 SUPPLY OF MATERIAL

**3.1** General requirements relating to the supply of hot rolled carbon steel sheets and strips shall conform to IS 8910:1978.

**3.2** Hot rolled carbon steel sheets and strips shall be supplied either with mill edges or flattened and sheared edges.

**3.3** Unless agreed otherwise, for cold rolling purposes, the material shall be supplied on the chemical composition basis only as given in Table 1.

## 4 GRADES

There shall be 4 grades of hot rolled carbon steel sheet and strip designated as follows:

- a) HR1 - Commercial quality – intended for general fabrication purposes where sheets or strips are used in the flat or for bending, moderate forming and welding operations
- b) HR2 – Drawing quality Intended for applications where drawing, severe forming and welding are involved
- c) HR3 – Deep drawing quality
- d) HR4 – Extra deep drawing quality

## 5 MANUFACTURE

**5.1** Steel shall be manufactured by any process of steel making at the discretion of the manufacturer.

**5.2** Steel sheets and strips shall be supplied in the rimmed semi-killed or killed condition as agreed to between the purchaser and the manufacturer. However, HR4 grade shall be supplied in killed condition only.

**5.3** Steels which are fully aluminium killed shall be capable of withstanding a stabilization or ageing test when cold rolled annealed and skin-passed.

## 6 CHEMICAL COMPOSITION

### 6.1 Ladle Analysis

Ladle analysis of the material when carried out either by the method specified in the relevant part of IS 228 or any other established instrumental/chemical method, shall be as given in Table 1. In case of dispute, the procedure given in the relevant part of IS 228 shall be the referee method.

**Table 1 Chemical Composition  
(Clause 6.1)**

Quality			Constituent, Percent, <i>Max</i>				
Designation	Old Designation	Name	Carbon	Manganese	Phosphorus	Sulphur	Titanium
HR1	O	Commercial (Ordinary)	0.12	0.60	-	0.035	-
HR2	D	Drawing	0.10	0.45	-	0.035	-
HR3	DD	Deep Drawing	0.08	0.40	-	0.030	-
HR4	EDD	Extra Deep Drawing	0.08	0.35	0.150	0.030	-
HR5	(New Grade)	Extra Deep Drawing (stabilized interstitial free)	0.06	0.25	0.020	0.020	0.15

#### NOTES

1. Steels of these grades can be supplied with the addition of micro-alloying elements like boron, titanium, niobium and vanadium. The micro alloying elements shall not exceed 0.008 percent in case of boron and 0.15 percent in case of other elements.
2. The nitrogen content of the steel shall not be more than 0.007 percent. For aluminium killed or silicon-aluminium killed, the nitrogen content shall not exceed 0.012 percent. This has to be ensured by the manufacturer by occasional check analysis.
3. Grade HR4 and HR5 shall be supplied in fully aluminium killed condition or aluminium with stabilizing elements.
4. When the steel is aluminium killed, the total aluminium content shall not be less than 0.02 percent. When the steel is silicon killed, the silicon content shall not be less than 0.10 percent. When the steel is aluminium silicon killed, the silicon content shall not be less than 0.03 percent and total aluminium content shall not be less than 0.01 percent.
5. When copper bearing steel is required the copper content shall be between 0.20 and 0.35 percent. In case of product analysis, the copper content shall be between 0.017 and 0.38 percent.
6. HR 5 grade is for cold rolling only.
7. Restricted chemistry for HR4 and HR5 grades may be mutually agreed to between the purchaser and the supplier.

### 6.2 Product Analysis

Permissible variations in case of product analysis from the limits specified in Table 1 shall be as given in Table 2.

**Table 2 Permissible Variations for Product Analysis  
(Clause 6.2)**

Constituent	Percentage Limit of Constituent	Variation Over Specified Limit, Percent <i>Max</i>
Carbon	Up to 0.12	0.02
Manganese	Up to 0.50	0.03
	Above 0.50	0.04
Sulphur		0.005
Phosphorus		0.005

Note – Product analysis shall not be applicable to rimming steel.

## 7 TENSILE TEST

### 7.1 Number of Tensile Tests

One tensile test shall be taken from each lot of 50 t of material or a part thereof from each cast. However, in case of material supplied after heat treatment, one tensile test shall be conducted for each heat treatment batch or a lot of 50 t whichever is less.

**7.1.1** Where sheet and strip of more than one thickness are rolled from the same cast, one additional tensile test shall be made for each thickness of sheet and strip.

### 7.2 Tensile Test Pieces

Tensile test pieces shall normally be cut transverse to the directing of rolling. Longitudinal test pieces may be cut in the case of strips having width less than 150 mm.

**7.3** When tested in accordance with IS 1608 as applicable, the tensile strength, yield stress and percentage elongation shall be as given in Table 3.

**Table 3 Tensile Properties  
(Clause 7.3)**

Quality			Tensile Strength  $R_m^{2)}$  max  MPa	Percentage Elongation After Fracture $A^{3), 4)}$ min			
Designation	Old Designation	Name		$t \leq 3$		$t > 3$	
				Gauge length $L_o = 80$ mm	Gauge length $L_o = 50$ mm	Gauge Length $L_o = 5.65 \sqrt{S_o}$	Gauge Length $L_o = 50$ mm
HR1	O	Commercial (Ordinary)	440	23	24	28	29
HR2	D	Drawing	420	25	26	30	31
HR3	DD	Deep Drawing	400	28	29	33	34
HR4	EDD	Extra Deep Drawing	380	31	32	36	37
HR5	(New Grade)	Extra Deep Drawing (stabilized interstitial free)	-	-	-	-	-

**NOTES:**

1 1MPa = 1N/mm<sup>2</sup>

2 Minimum tensile strength for qualities HR, HR2, HR3 and HR4 would normally be expected to be 270 MPa. Where minimum tensile strength is required, the value of 270 MPa may be specified. All tensile strength values are determined to the nearest 10 MPa.

3 The non-proportional test piece with a fixed original gauge length (50 mm), up to 6 mm thick sheet can be used in conjunction with a conversion table. In case of dispute, however, only the results obtained on a proportional test piece will be valid for material 3 mm and over in thickness.

4 HR 5 grade is for cold rolling only, therefore mechanical properties are not applicable.

5 Where  $t$  is thickness of steel sheet, in mm

**7.3.1** If the percentage elongation of any test piece is less than that specified in Table 3 and if any part of the fracture is outside the middle half of the gauge length as scribed before the test, the test shall be discarded and a retest shall be carried out.

## **8 BEND TEST**

### **8.1 Number of Bend Tests**

One bend test shall be taken from each lot of 50 t of material or a part thereof from each cast. However, in the case of material supplied after heat-treatment, one bend test shall be conducted for each heat-treated batch or a lot of 50 t, whichever is less.

**8.1.1** When material is supplied in coils, one bend test shall be conducted from either end of the coil.

**8.1.2** When sheet and strip of more than one thickness are rolled from the same cast, one additional bend test shall be made for each thickness of sheet and strip.

**8.2** Bend test shall be carried out in accordance with IS 1599.

**8.2.1** Bend test piece shall be cut so that the axis of the bend is parallel to the direction of rolling, that is, the longer axis of the test piece shall be at 90° to the direction of rolling.

**8.2.2** The test piece shall be bend cold through 180°. The internal diameter of the bend for different grades of material shall be as given in Table 4. The test pieces shall be deemed to have passed the test if the outer convex surface is free from cracks after complete bending.

Table 4 Internal Diameter of Bend  
(Clause 8.2.2)

Grade	Internal Diameter of Bend
HR1	2t
HR2	t
HR2	Close
HR4	Close
Where <i>t</i> is the thickness of test piece	

**8.2.2.1** It is sometimes, difficult to ensure that the material is accurately following the radius. In case of dispute, the test piece may be pushed into a block of lead by a former of appropriate diameter.

## **9 CUPPING TEST**

**9.1** Cupping test as specified in IS 10175 may be carried out only for sheets and strips of HR2, HR3 and HR4 grades having thickness from 0.5 mm up to 2 mm, if agreed to between the purchaser and the supplier.

**9.2** The cupping test values shall be agreed upon between the purchaser and the supplier.

## **10 STRAIN AGEING TEST**

**10.1** The test is to be carried out on grades where steel is supplied with non-aging properties/guarantee. This shall be agreed to between the purchaser and the supplier.

## 10.2 Selection of Sample

The sample shall be selected in such a way that the axis of bend is parallel to the direction of final rolling. In case of material too narrow to permit this, the axis of bend shall be of 90° to the direction of rolling.

10.3 Size of test piece shall be as follows:

Thickness	Size
Below 3 mm	75 mm long and 25 mm wide
3 mm and above	75 mm long and 40 mm wide

For smaller sizes, the maximum obtainable width shall be taken.

The edges of the test pieces shall be rounded or smoothed longitudinally to an approximate semicircle.

10.4 The test piece shall be bent cold through 90° over a radius equal to one and a half times the thickness, about an axis at right angles to the length of the test piece. Then the piece shall be heated at 100°C for 1 h ( or at 325 to 350°C for 15 min) and the sample cooled. The test piece shall be flattened by hammer and the piece shall not develop crack near the bend.

## 11 RETEST

If a test does not give the specified results, two additional tests shall be carried out at random on the same lot. Both retests shall conform to the requirements of this standard, otherwise, the lot shall be rejected.

## 12 FREEDOM FROM DEFECTS

12.1 The finished material in cut length shall be free from harmful defects which will affect the end use. When the material is supplied in the form of coils, the degree or amount of surface defects are expected to be more than in cut length sheets since the inspection of coils does not afford the same opportunity to reject the portion containing defects as with cut length. However, an excessive number of defects may be cause for rejection. The standards for acceptance in such case can be agreed to between the purchaser and the supplier.

12.2 Steel sheets supplied shall be free from coil breaks and waviness in accordance with the purchaser's requirements.

12.3 Edges may be mill edges or slit edges as agreed to between the supplier and purchaser. When mill edges are specified, the depth of the defects shall be within 5 mm from the edges of the coils on both sides.

## 13 DIMENSIONS AND TOLERANCES

13.1 Dimensions of steel sheet and strip shall conform to the dimensions specified in IS 1730.

13.2 Unless otherwise agreed the dimensional tolerances for hot-rolled steel sheet shall be as given in **Doc: MTD 4(4693)** (Based on ISO 16160)

13.2.1 Unless otherwise agreed the restricted thickness tolerances shall be as given in **Doc: MTD 4(4693)** (Based on ISO 16160)

## 14 CALCULATION OF WEIGHT

The mass of the material shall be calculated on the basis that steel weighs 7.85 g/cm<sup>2</sup>.

## **15 DELIVERY**

**15.1** The material may be supplied in any one (or, in combination) of the following conditions subject to mutual agreement between the supplier and the purchaser:

- a) Hot rolled;
- b) Annealed;
- c) Normalized, and
- d) Descaled

**15.2** Subject to prior agreement between the manufacturer and the purchaser, a suitable protective treatment may be given to the material.

## **16 MARKING**

**16.1** Sheets shall be supplied in bundles, and strips either in bundles or coils. Each bundle shall carry a metal tag bearing the cast number and the manufacturer's name or trade-mark. Alternatively, the top sheet or strips in each bundle shall be legibly marked with the cast number, name of the manufacturer or trade-mark.

### **16.2 Standard Marking**

The material may also be marked with Standard Mark.

**16.2.1** The use of the Standard Mark is governed by the provisions of the Bureau of Indian Standards Act 1986, and the Rules and Regulations made thereunder. The details of conditions under which the licence for the use of Standard Mark may be granted to manufacturers or producers may be obtained from the Bureau of Indian Standards